(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 333 660 A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 89810187.8

(22) Date of filing: 09.03.89

(51) Int. Cl.4: C 08 K 5/00
C 08 L 59/00
//(C08K5/00,5:13,5:20),
(C08K5/00,5:13,5:25)

(30) Priority: 16.03.88 US 170187

(43) Date of publication of application:
20.09.89 Bulletin 89/38

(84) Designated Contracting States: DE FR GB IT NL

(71) Applicant: CIBA-GEIGY AG
Klybeckstrasse 141
CH-4002 Basel (CH)

(72) Inventor: Capocci, Gerald A.
25 Greenway Drive
Greenwich, CT 06431 (US)

Zappia, Jean M.
3 Hollywood Street
Mohegan Lake, NY 10547 (US)

(54) Stabilization systems for polyacetals.

(57) A blend of a phenolic antioxidant and a hydrazine or oxamido derivative in appropriate proportions for use in stabilizing acetal homo- and copolymers against oxidative and thermal degradation.

EP 0 333 660 A2

Bundesdruckerei Berlin

Description

Stabilization Systems for Polyacetals

The instant invention pertains to an acetal homo- or copolymer composition comprising a hindered phenol and a specific hydrazine compound or oxamido compound, to a method of stabilizing acetal homo- or copolymers as well as to a method of reducing color formation in acetal homo- or copolymers which contain a hindered phenol.

Polyacetal homo- and copolymers are well known to those skilled in the art. These materials are a suitable replacement for metal in numerous applications as a result of properties such as high strength and stiffness, good fatigue life, excellent resilience and thoughness, low moisture sensitivity, solvent resistance, excellent electrical characteristics and the capability to maintain these properties at elevated temperatures. The molecular structure of the polymer is that of a linear acetal, consisting of unbranched polyoxymethylene chains of substantial length, generally averaging more than 1000 $-CH_2O-$ units. The acetal homopolymers are, for example, prepared by the polymerization of anhydrous formaldehyde or by the polymerization of trioxane. Acetal copolymers are typified, for example, by the polymerization product of trioxane and a cyclic ether such as ethylene oxide.

Since polyacetals are subject to oxidative and thermal degradation and discoloration, a wide variety of light stabilizers and antioxidants have been recommended for use therein. Included among the latter are diverse hindered phenolic antioxidants as reflected for example in U.S. Patents 3,285,855, 3,644,482 and the like; as well as various hydrazine compounds as reflected for example in U.S. Patents 3,110,696 and 3,660,438. Although these groups of compounds have provided antioxidant properties to polyacetals, levels of discoloration during storage and exposure particularly with the hindered phenols have proven to be unacceptably high for certain end uses. This potential deficiency is aggravated by the fact that the hindered phenol primary stabilizers are required in order to provide maximum thermal stability, the latter not being provided by the individual use of co-stabilizers even at higher concentration levels.

It has now been discovered that by including a special hydrazine or oxamido compound with a special hindered phenol in the proportions noted hereinafter as a stabilizing system for acetal homo- and copolymers, total stabilizing activity is achieved. Thus, the blend provides excellent stabilization against both oxidative and thermal degradation. Of primary importance, the combination provides significantly improved performance in the area where the individual hindered phenol is lacking, namely, in resistance to discoloration during storage and/or exposure to environmental conditions. In fact, contrary to expectation, the use of higher levels of hindered phenol in such combinations does not result in a concomitant increase in discoloration of the acetal polymer.

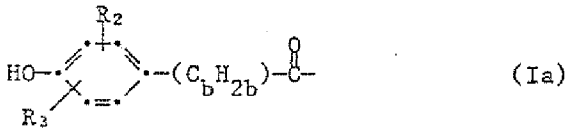
As previously noted, the applicable hindered phenols and hydrazine or oxamido compounds are known to those skilled in the art and have been identified as antioxidants for use in acetal polymers. Various blends of the hindered phenol and hydrazine components have been identified for use as stabilizer systems for polyolefins, polyurethans and various elastomers. In addition, U.S. Patent 3,940,365 describes moulding compositions based on poly(oxymethylene) which contain a phenolic antioxidant and a specific compound having a nucleating effect. However, the unexpected performance pattern achieved with the use of the instant blends clearly provide a distinct situation.

The instant invention pertains to an acetal homo- or copolymer which comprises

(a) a hindered phenol corresponding to the formula I, II, III, IV, V, VI or VII,

$R_1X-(C_aH_{2a})-Q$ (I)

wherein R_1 is a group of the formula Ia,

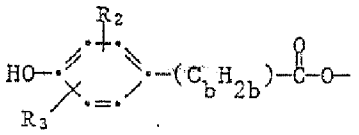


(Ia)

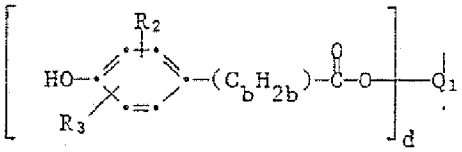
X is oxygen or sulfur, a is an integer from 6 to 30, preferably 6 to 18, b is an integer from 0 to 6, R_2 and R_3 are independently C_1-C_{18}alkyl, C_5-C_{12}cycloalkyl, phenyl or C_7-C_9aralkyl, and R_2 is also hydrogen, Q is hydrogen or $-A-(C_yH_{2y})-R_4$, A is oxygen, sulfur or $-\underset{\underset{B}{|}}{N}-$,

y is an integer from 2 to 20,

B is C_1-C_4alkyl or C_1-C_4alkanoyl, and R_4 is hydrogen, hydroxy, C_1-C_4alkanoyloxy or a group of the formula Ib,

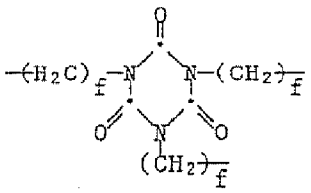


(Ib);



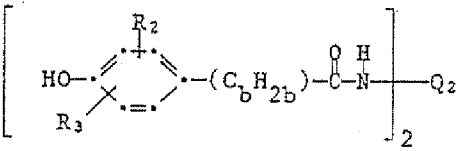
(II)

wherein R_2, R_3 and b are as defined above, d is an integer from 2 to 6, and Q_1 is a d-valent aliphatic hydrocarbon of 1 to 18 carbon atoms, a d-valent aromatic or aromatic aliphatic hydrocarbon of 6 to 20 carbon atoms or a group of the formula IIa



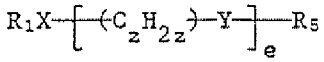
(IIa)

wherein f is an integer from 1 to 4;



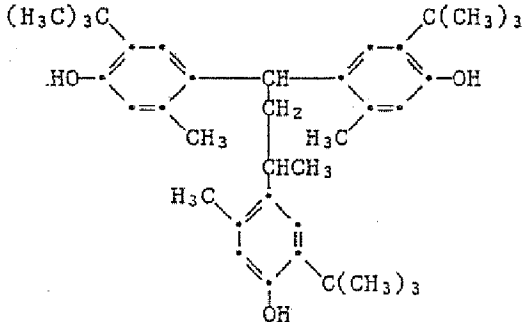
(III)

wherein R_2, R_3 and b are as defined above, and Q_2 is C_1-C_{18}alkylene;

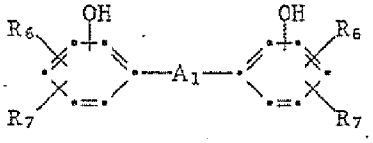


(IV)

wherein R_1 and X are as defined above, z is an integer from 2 to 6, e is an integer from 3 to 40, preferably 3 to 10, Y is oxygen or sulfur, and R_5 is hydrogen, C_1-C_4alkyl or a group of the formula Ia;

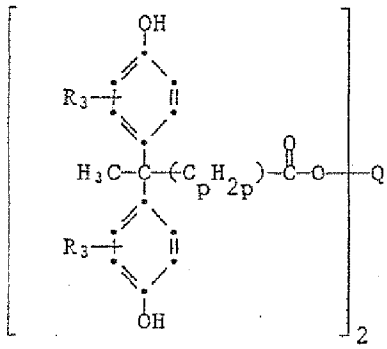


(V);



(VI)

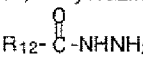
wherein R_6 and R_7 are independently C_1-C_{18}alkyl, C_5-C_{12}cycloalkyl, phenyl or C_7-C_9aralkyl, and R_6 is also hydrogen, and A_1 is a group $>C(R_8)R_9$ wherein R_8 and R_9 are independently hydrogen or C_1-C_6alkyl;



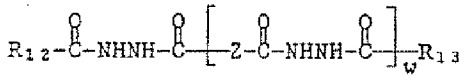
(VII)

wherein R_3 is as defined above, p is 1 or 2 and Q_3 is C_2-C_{10}alkylene; and

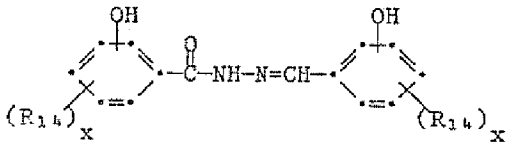
(b) a hydrazine compound corresponding to the formula VIII, IX or X



(VIII),

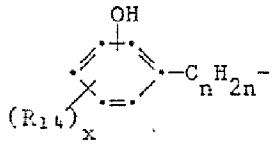


(IX),



(X)

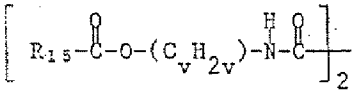
wherein R_{12} and R_{13} are independently C_1-C_{18}alkyl, C_1-C_{18}alkyloxy, phenyl, C_7-C_9aralkyl or a group of the formula VIIIa,



(VIIIa)

Z is a direct bond, C_1-C_{18}alkylene or phenylene, the radicals R_{14} are independently C_1-C_{18}alkyl, C_5-C_{12}cycloalkyl, phenyl or C_7-C_9aralkyl, w is 0 or 1, x is an integer from 0 to 4 and n is an integer from 0 to 6, with the proviso that x is different from zero, when w is 1; or

(c) an oxamido compound of the formula XI



(XI)

wherein R_{15} is C_1-C_{18}alkyl, phenyl, C_7-C_9aralkyl or a group of the formula VIIIa and v is an integer from 0 to 6, preferably 1 to 6, in particular 2 to 6; the weight ratio of the components (a):(b) or (a):(c) is 20:1 to 1:10. Alkyl is for example methyl, ethyl, propyl, n-butyl, tert-butyl, pentyl, hexyl, heptyl, octyl, 1,1,3,3-tetramethylbutyl, nonyl, decyl, undecyl, dodecyl or octadecyl.

C_1-C_{18}alkyloxy is for example methoxy, ethoxy, propoxy, n-butoxy, tert-butoxy, pentyloxy, hexyloxy, heptyloxy, octyloxy, nonyloxy, decyloxy, undecyloxy, dodecyloxy or octadecyloxy.

C_1-C_4alkanoyl is for example acetyl, propionyl or butyryl.

C_1-C_4alkanoyloxy is for example acetyloxy, propionyloxy or butyryloxy.

C_5-C_{12}cycloalkyl is for example cyclopentyl, cyclohexyl or cyclooctyl. Cyclohexyl is preferred.

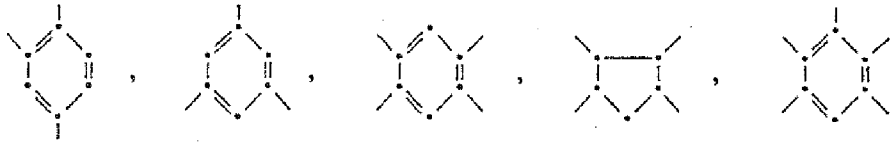
C_7-C_9aralkyl is in particular C_7-C_9phenylalkyl, for example benzyl, α-methylbenzyl, α,α-dimethylbenzyl or phenylethyl. Benzyl is preferred.

C_1-C_{18}alkylene is for example methylene, dimethylene, trimethylene, tetramethylene, pentamethylene, hexamethylene, heptamethylene, octamethylene, decamethylene, dodecamethylene or octadecamethylene.

For compounds of formula II, Q_1 as a bivalent hydrocarbon can be e.g. straight-chain or branched C_2-C_{10}alkylene or C_2-C_6alkylidene such as, for example, ethylene, ethylidene, trimethylene, tetramethylene, pentamethylene, 2,2-dimethylpropane-1,3-diyl, hexamethylene, heptamethylene, octamethylene, decamethylene, 2,2-pentamethylene-propane-1,3-diyl, and cyclohexylene or C_6-C_{10}arylene such as, for example,

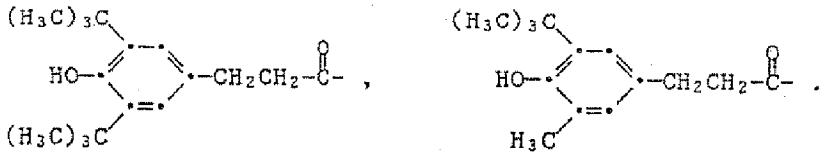
phenylene, phenylene substituted by one or more C_1-C_4alkyl, or naphthylene.

Q_1 as a trivalent, tetravalent or pentavalent hydrocarbon can be e.g. a group of the following formulae

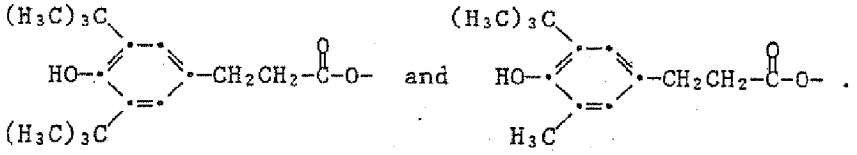


or alkanetriyl of 3 to 6 carbon atoms, such as e.g. glyceryl or trimethylylpropane or alkanetetrayl of 4 to 6 carbon atoms such as e.g. pentaerythrityl.

Formula Ia represents preferably one of the following groups:



Formula Ib is in particular one of the groups



In the group of the formula IIa f is preferably 2.

Those compositions are preferred, wherein component (a) is a compound of the formula I, II, III, IV, V or VI, in particular I, II, III or IV.

Z is preferably a direct bond or C_1-C_6alkylene.

Compounds of formula I which are preferred exhibit X as oxygen, b as an integer from 0 to 2, R_2 and R_3 as alkyl of 1 to 8 carbon atoms, A as oxygen, y as 2, R_4 as hydrogen or a group of the formula Ib. Particularly preferred are those compounds wherein R_2 and R_3 are tert-butyl positioned ortho to the hydroxyl group and b is 2. A specific compound of preference is octadecyl 3-(3′,5′-di-tert-butyl-4′-hydroxyphenyl)propionate.

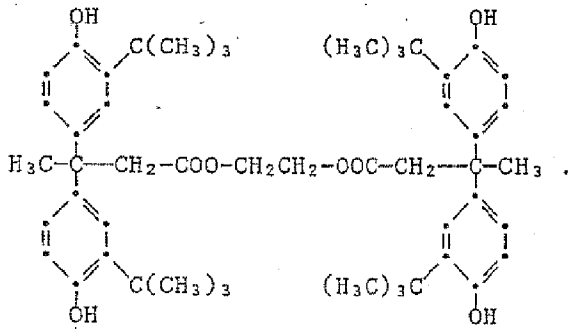
Compounds of formula II which are preferred exhibit R_2 and R_3 as C_1-C_8-alkyl, in particular tert-butyl positioned ortho to the hydroxyl group, b as 2, d as 2 or 4 and Q_1 as C_2-C_{10}alkylene or pentaerythrityl. Specific compounds of preference are 1,6-hexamethylene bis[3′,5′-di-tert-butyl-4′-hydroxyhydrocinnamate] and tetrakis[methylene 3-(3′,5′-di-tert-butyl-4′-hydroxyphenyl)propionate]methane.

Compounds of formula III which are preferred exhibit R_2 and R_3 as C_1-C_8alkyl and preferably tert-butyl positioned ortho to the hydroxyl group, b as 2 and Q_2 as C_2-C_6alkylene. The specific compound of preference is N,N′-hexamethylene bis[3,5-di-tert-butyl-4-hydroxyhydrocinnamamide].

Compounds of formula IV which are preferred exhibit X and Y as oxygen, b as an integer from 0 to 2, R_2 and R_3 as alkyl of 1 to 8 carbon atoms, z as 2, e as an integer from 3 to 20, and R_5 as a group of the formula Ia. Particularly preferred are those compounds wherein R_2 and R_3 are tert-butyl positioned ortho to the hydroxyl group. A specific compound of preference is triethylene glycol bis[3-(3′,5′-di-tert-butyl-4′-hydroxyphenyl)-propionate].

Compounds of formula VI which are preferred exhibit R_6 and R_7 as methyl or tert-butyl and R_8 and R_9 as hydrogen or methyl. Specific compounds of preference are bis[2-hydroxy-3-tert-butyl-5-methylphenyl]methane and 1,1-bis[2′-hydroxy-3′,5′-di-tert-butylphenyl]ethane.

A preferred compound of formula VII is



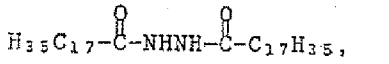
Preferred compositions of the invention are those wherein component (a) is octadecyl 3-(3′,5′di-tert-butyl-4-hydroxyphenyl)propionate, 1,6-hexamethylene bis[3′,5′-di-tert-butyl-4′-hydroxyhydrocinnamate], tetrakis-[methylene 3-(3′,5′-di-tert-butyl-4′-hydroxyphenyl)propionate]methane,
N,N′-hexamethylene bis[3,5-di-tert-butyl-4-hydroxyhydrocinnamamide] or triethylene glycol bis[3-(3′,5′-di-tert-butyl-4′-hydroxyphenyl)propionate].

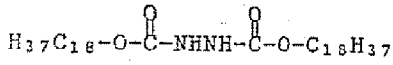
According to a further preferred embodiment in component (b) R_{12} and R_{13} are independently C_1-C_{18}alkyl or a group of formula VIIIa, Z is a direct bond or C_1-C_6alkylene and the radicals R_{14} are independently C_4-C_8alkyl, C_5-C_6cycloalkyl, phenyl or benzyl.

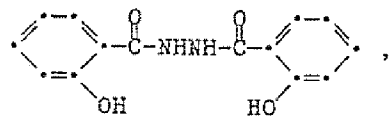
Preferred groups of the formula VIIIa and preferred compounds of the formula X are those wherein the OH group is either in the ortho- or para-position. When the OH group is in the para-position, the groups of the formula VIIIa preferably contain two R_{14} radicals positioned ortho to the hydroxyl group, which are alkyl of 4 to 8 carbon atoms and most preferably tert-butyl.

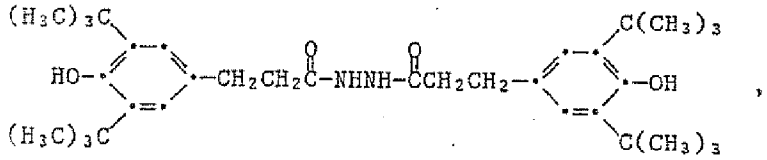
With respect to compounds of formula X, the OH group is preferably in the ortho-position to the linking chain.

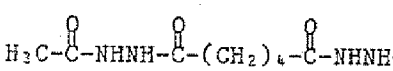
Representative compounds of component (b) include

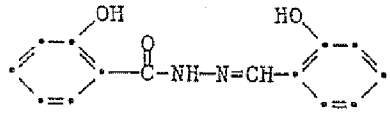




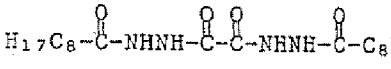








and



Another preferred composition of the instant invention contains as component (a) 1,6-hexamethylene bis[3′,5′-di-tert-butyl-4′-hydroxyhydrocinnamate] and as component (b) N,N′-bis[β-(3,5-di-tert-butyl-4-hydroxyphenyl)propionyl]hydrazine. The combination of these components particularly reveals a performance

improvement in the hindered phenol.

Preferred compositions are also those which contain components (a) and (c).

In compounds of the formula XI R_{15} is preferably a group of the formula VIIIa with the OH radical in the para-position and two R_{14} groups positioned ortho to the hydroxyl group, R_{14} being preferably tert-butyl. A representative compound is 2,2′-oxamido-bis[ethyl 3-(3′,5′-di-tert-butyl-4′-hydroxyphenyl)propionate] (®NAUGARD XL-1 from Uniroyal).

Methods for preparing the compounds of component (a) are well known to those skilled in the art. Specific reference is made to U.S. Pat. Nos. 3,285,855, 3,531,483, 3,564,047, 3,632,553, 3,644,482, 3,944,594, 4,032,562 and 4,507,420 for information regarding the phenols of formula I-IV and VI and their methods of preparation. The compound of formula V is ®TOPANOL CA available from ICI Corp. The compounds of formula VII can be prepared as described, for example, in U.S. Patent 3,960,928.

The compounds of component (b) and methods for their preparation are disclosed in U.S. Pat. Nos. 3,110,696 and 3,660,438, said disclosures being fully incorporated herein.

In general, the blends of the present invention are employed in from about 0.01 to about 10 % by weight of the stabilized composition, although this will vary with the particular application. An advantageous range is from about 0.05 to about 2 %, and especially 0.1 to about 1 %. The weight ratio of component (a) to component (b) or component (c) will generally range from 20:1 to 1:10, preferably 9:1 to 1:9, and most preferably 2-3:1.

The stabilizers of the instant invention, either individually or in combination, may readily be incorporated into the acetal polymers by conventional techniques, at any convenient stage prior to the manufacture of shaped articles therefrom. For example, the stabilizers may be mixed with the polymer in dry powder form, or a suspension or emulsion of the stabilizer may be mixed with a solution, suspension, or emulsion of the polymer. The resulting stabilized polymer compositions of the invention may optionally also contain various conventional additives. Included among these additives are basic co-stabilizers such as calcium citrate, melamine, cyanoguanidine, polyamides, alkali and alkaline earth metal salts of high fatty acids, and amines; phosphites and phosphonites; peroxide-destroying compounds such as esters of thiodipropionic acid; and the like.

The instant invention also relates to a method of stabilizing an acetal homo- or copolymer against thermal or oxidative degradation, which comprises incorporating into said acetal components (a) and (b) or (a) and (c) as defined above.

Another embodiment of the instant invention is a method of reducing color formation in acetal homo- or copolymers containing a hindered phenol (component (a)), which comprises incorporating into said acetal homo- or copolymers component (b) or (c) as defined above.

The following examples illustrate the embodiments of this invention.

Test compounds

A - 1,6-hexamethylene bis[3′,5′-di-tert-butyl-4′-hydroxyhydrocinnamate]
B - triethylene glycol bis[3-tert-butyl-5-methyl-4-hydroxyphenyl]propionate
C - tetrakis[methylene 3-(3′,5′-di-tert-butyl-4′-hydroxyphenyl)propionate]methane
D - N,N′-hexamethylene bis[3,5-di-tert-butyl-4-hydroxyhydrocinnamamide]
E - octadecyl 3-(3′,5′-di-tert-butyl-4′-hydroxyphenyl)propionate
F - 1,3,5-tris[3′,5′-di-tert-butyl-4′-hydroxybenzoyloxyethyl]isocyanurate
G - 1,1,3-tris[3′-tert-butyl-4′-hydroxy-5′-methylphenyl]butane
H - 1,1-bis[3′-tert-butyl-4′-hydroxy-5′-methylphenyl]butane
J - N,N′-bis[β-(3,5-di-tert-butyl-4-hydroxyphenyl)propionyl]hydrazine
K - 2,2′-oxamido-bis[ethyl 3-(3′,5′-di-tert-butyl-4′-hydroxyphenyl)propionate]

Example 1:

The additives in the indicated concentrations are dry blended into polyoxymethylene resin [trioxane-ethylene oxide copolymer (®CELCON from Celanase) with base stabilization system of 0.2 % bis-stearamide and 0.1 % calcium hydroxystearate] and extruder compounded (single extrusion) into pellets at 185°C. The pellets are stored in a dark area in glass petri dishes at ambient temperatures for the indicated time periods and specimen yellowness index (YI) is determined according to ASTM D 1925.

Components	Conc. (% by wt.)	Yellowness Index		
		Initial	64 Days	131 Days
A	0.5	3.6	10.4	11.3
J	0.5	3.6	2.7	2.3
A/J	0.25/0.25	2.0	1.5	1.3
A/J	0.3/0.2	1.5	1.2	1.2
A/J	0.35/0.15	2.3	2.0	1.8
A/J	0.4/0.1	1.9	1.5	1.4
A/J	0.45/0.05	1.4	1.2	1.5
A/J	0.475/0.025	1.2	1.0	1.0
A/J	0.2/0.3	1.0	1.4	1.3
A/J	0.15/0.35	2.6	1.8	1.6
A/J	0.1/0.4	2.7	2.1	2.0
A/J	0.05/0.45	2.2	1.7	1.6
K	0.5	1.7	1.7	2.0
A/K	0.25/0.25	1.0	1.9	2.1
A/K	0.35/0.15	1.4	2.8	3.2
A/K	0.45/0.05	1.7	3.0	3.4
A/K	0.15/0.35	1.6	2.3	2.6
A/K	0.05/0.45	1.4	2.0	2.4

These data thus indicate the high resistance to discoloration during dark storage as exhibited by the stabilized systems of this invention. In addition, significant performance improvement is exhibited relative to component A, the more highly discoloration antioxidant.

Example II:

The procedures of Example I are repeated with the exception of certain of the components of the base acetal and the aging conditions. Thus, the formulated systems are subjected to oven aging at 80°C and to storage in water at 70°C.

COSTABILIZER 0.3 % Ca STEARATE	Oven aging at 80° C ΔYI at 20 Weeks	Storage in Water at 70° C YI at 20 Weeks
0.3 % A	18.7	33.4
0.3 % A + 0.01 % J	13.1	17.3
0.3 % A + 0.03 % J	12.0	14.7
0.3 % A + 0.05 % J	12.8	13.0
COSTABILIZER 0.15 % Ca CITRATE		
0.3 % A	18.0	10.2
0.3 % A + 0.01 % J	13.1	8.3
0.3 % A + 0.03 % J	14.5	8.6
0.3 % A + 0.05 % J	12.5	8.2
COSTABILIZER 0.3 % MELAMINE		
0.3 % A	10.6	9.8
0.3 % A + 0.01 % J	9.0	7.5
0.3 % A + 0.03 % J	8.1	9.0
0.3 % A + 0.05 % J	8.1	8.3
COSTABILIZER 0.3 % CYANOGUANIDINE		
0.3 % A	10.5	16.4
0.3 % A + 0.01 % J	9.0	7.2
0.3 % A + 0.03 % J	10.2	7.3
0.3 % A + 0.05 % J	10.1	6.0

Example III:

Example I is repeated utilizing a variety of phenolic antioxidants.

Additive	Conc (% by wt.)	YI Initial	YI 45 Days
A	0.5	4.0	16.2
A/J	0.4/0.1	4.1	5.0
B	0.5	3.8	4.0
B/J	0.4/0.1	2.2	2.8
C	0.5	3.8	13.0
C/J	0.4/0.1	2.5	4.0
D	0.5	3.0	8.0
D/J	0.4/0.1	3.0	4.1
E	0.5	4.1	26.6
E/J	0.4/0.1	5.5	7.2
F	0.5	9.2	14.5
F/J	0.4/0.1	8.5	11.1
G	0.5	11.1	14.9
G/J	0.4/0.1	5.4	7.2
H	0.5	12.0	21.8
H/J	0.4/0.1	5.6	7.0
J	0.5	4.1	5.3

Example IV:

Example III is repeated with the exception that the resulting samples are subjected to oven aging for five days at 110°C.

Additive	Conc. (% by wt.)	YI - Oven Aged
C	0.5	23.3
C/J	0.475/0.025	17.7
E	0.5	23.2
E/J	0.475/0.025	13.3
F	0.5	39.7
F/J	0.475/0.025	25.9
J	0.5	28.3

It is thus seen that the instant combination of antioxidants provides significantly improved stabilization effectiveness in acetal polymers. This improvement is particularly evident in a key indicia of stabilization, namely, resistance to discoloration.

In summary, this invention provides antioxidant systems for stabilizing acetal polymers against oxidative and thermal degradation. Variations may be made in various elements thereof without departing from the scope of the invention as defined by the following claims.

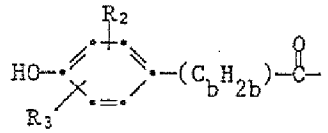
Claims

1. An acetal homo- or copolymer which comprises

(a) a hindered phenol corresponding to the formula I, II, III, IV, V, VI or VII,

$R_1X-(C_aH_{2a})-Q$ (I)

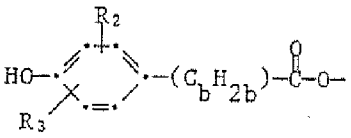
wherein R_1 is a group of the formula Ia,



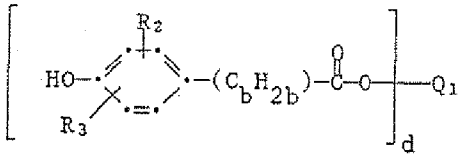
(Ia)

X is oxygen or sulfur, a is an integer from 6 to 30, b is an integer from 0 to 6, R_2 and R_3 are independently C_1-C_{18}alkyl, C_5-C_{12}cycloalkyl, phenyl or C_7-C_9aralkyl, and R_2 is also hydrogen, Q is hydrogen or $-A(C_yH_{2y})-R_4$, A is oxygen, sulfur or $-\underset{\underset{B}{|}}{N}-$,

y is an integer from 2 to 20,
B is C_1-C_4alkyl or C_1-C_4alkanoyl, and R_4 is hydrogen, hydroxy, C_1-C_4alkanoyloxy or a group of the formula Ib,

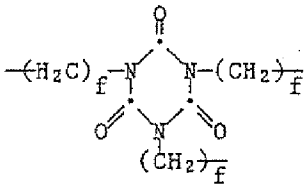


(Ib);



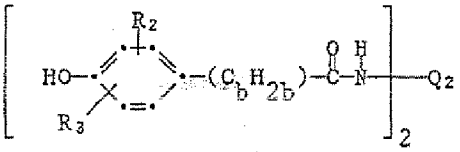
(II)

wherein R_2, R_3 and b are as defined above, d is an integer from 2 to 6, and Q_1 is a d-valent aliphatic hydrocarbon of 1 to 18 carbon atoms, a d-valent aromatic or aromatic aliphatic hydrocarbon of 6 to 20 carbon atoms or a group of the formula IIa



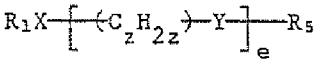
(IIa)

wherein f is an integer from 1 to 4;



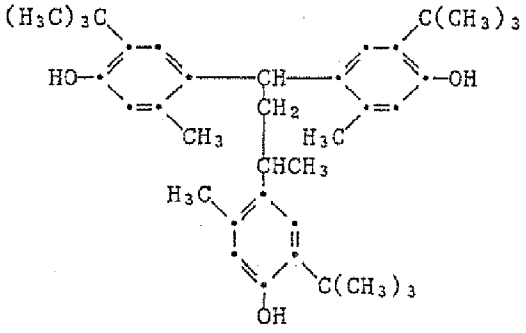
(III)

wherein R_2, R_3 and b are as defined above, and Q_2 is C_1-C_{18}alkylene;

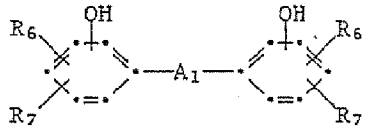


(IV)

wherein R_1 and X are as defined above, z is an integer from 2 to 6, e is an integer from 3 to 40, Y is oxygen or sulfur, and R_5 is hydrogen, C_1-C_4alkyl or a group of the formula Ia;

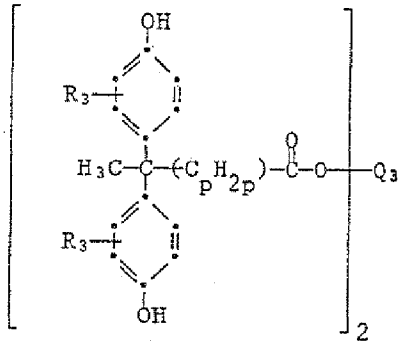


(V);



(VI)

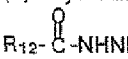
wherein R_6 and R_7 are independently C_1-C_{18}alkyl, C_5-C_{12}cycloalkyl, phenyl or C_7-C_9aralkyl, and R_6 is also hydrogen, and A_1 is a group $>C(R_8)R_9$ wherein R_8 and R_9 are independently hydrogen or C_1-C_8alkyl;



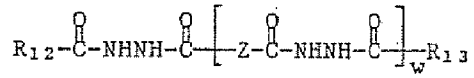
(VII)

wherein R_8 is as defined above, p is 1 or 2 and Q_3 is C_2-C_{10}alkylene;
and

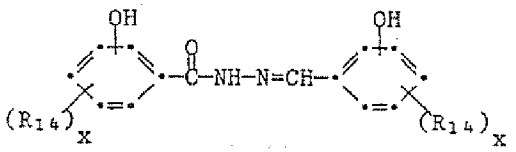
(b) a hydrazine compound corresponding to the formula VIII, IX or X



(VIII),

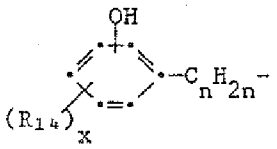


(IX),



(X)

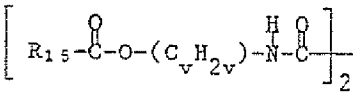
wherein R_{12} and R_{13} are independently C_1-C_{18}alkyl, C_1-C_{18}alkyloxy, phenyl, C_7-C_9aralkyl or a group of the formula VIIIa,



(VIIIa)

Z is a direct bond, C_1-C_{18}alkylene or phenylene, the radicals R_{14} are independently C_1-C_{18}alkyl, C_5-C_{12}cycloalkyl, phenyl or C_7-C_9aralkyl, w is 0 or 1, x is an integer from 0 to 4 and n is an integer from 0 to 6, with the proviso that x is different from zero, when w is 1; or

(c) an oxamido compound of the formula XI



(XI)

wherein R_{15} is C_1-C_{18}alkyl, phenyl, C_7-C_9aralkyl or a group of the formula VIIIa and v is an integer from 0 to 6; the weight ratio of the components (a):(b) or (a):(c) is 20:1 to 1:10.

2. The composition of claim 1, wherein said hindered phenol corresponds to the formula I, II, III, IV, V or VI.

3. The composition of claim 1, wherein said hindered phenol corresponds to formula I.

4. The composition of claim 1, wherein said hindered phenol corresponds to formula I and X is oxygen, b is an integer from 0 to 2, R_2 and R_3 are independently C_1-C_8alkyl, A is oxygen, y is 2 and R_4 is hydrogen or a group of the formula Ib.

5. The composition of claim 4, wherein R_2 and R_3 are tert-butyl positioned ortho to the hydroxyl group and b is 2.

6. The composition of claim 1, wherein said hindered phenol corresponds to formula II.

7. The composition of claim 1, wherein said hindered phenol corresponds to formula II and R_2 and R_3 are independently C_1-C_8alkyl, b is 2, d is 2 or 4 and Q_1 is C_2-C_{10}alkylene or pentaerythrityl.

8. The composition of claim 1, wherein said hindered phenol corresponds to formula III.

9. The composition of claim 1, wherein said hindered phenol corresponds to formula III and R_2 and R_3 are independently C_1-C_8alkyl, b is 2 and Q_2 is C_2-C_6alkylene.

10. The composition of claim 1, wherein said hindered phenol corresponds to formula IV.

11. The composition of claim 1, wherein said hindered phenol corresponds to formula IV and X and Y are oxygen, b is an integer from 0 to 2, R_2 and R_3 are independently C_1-C_8alkyl, z is 2, e is an integer from 3 to 20 and R_5 is a group of the formula Ia.

12. The composition of claim 11, wherein R_2 and R_3 are tert-butyl positioned ortho to the hydroxyl group.

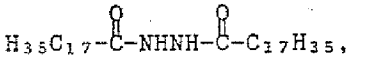
13. The composition of claim 1, wherein said hindered phenol is octadecyl 3-(3′,5′-di-tert-butyl-4′-hydroxyphenyl)propionate, 1,6-hexamethylene bis[3′,5′-di-tert-butyl-4′-hydroxyhydrocinnamate], tetrakis-[methylene 3-(3′,5′-di-tert-butyl-4′-hydroxyphenyl)propionate]methane, N,N′-hexamethylene bis[3,5-di-tert-butyl-4-hydroxyhydrocinnamamide] or triethylene glycol bis[3-(3′,5′-di-tert-butyl-4′-hydroxyphenyl)propionate].

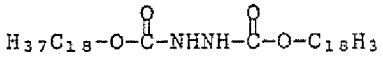
14. The composition of claim 1, wherein in component (b) R_{12} and R_{13} are independently C_1-C_{18}alkyl or a group of formula VIIIa, Z is a direct bond or C_1-C_6alkylene and the radicals R_{14} are independently C_4-C_8alkyl, C_5-C_6cycloalkyl, phenyl or benzyl.

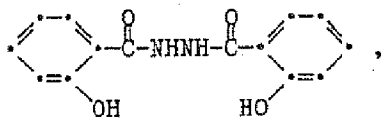
15. The composition of claim 14, wherein the OH in the group of the formula VIIIa and in the compounds of formula (X) is positioned either in the 2- or 4-position.

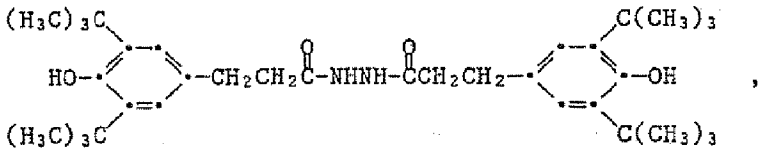
16. The composition of claim 15, wherein the OH in the group of the formula VIIIa is in the para-position, x is 2 and each R_{14} is tert-butyl positioned ortho to the OH group.

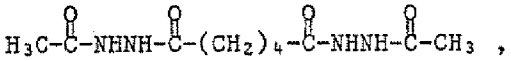
17. The composition of claim 1, wherein said hydrazine is

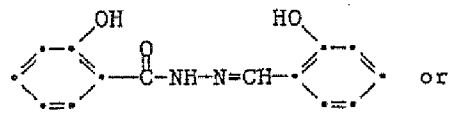


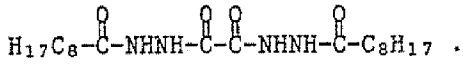












18. The composition of claim 1, wherein said hindered phenol is 1,6-hexamethylene bis[3,5-di-tert-butyl-4-hydroxyhydrocinnamate] and said hydrazine compound is N,N′-bis[β-(3,5-di-tert-butyl-4-hydroxyphenyl)propionyl]hydrazine.

19. The composition of claim 1 comprising components (a) and (c).

20. The composition of claim 19, wherein component (c) is 2,2′-oxamido-bis[ethyl 3-(3′,5′-di-tert-butyl-4′-hydroxyphenyl)propionate].

21. The composition of claim 1 which additionally contains a basic co-stabilizer selected from the group consisting of calcium citrate, melamine, cyanoguanidine, polyamides, alkali and alkaline earth metal salts of fatty acids, amines, phosphites, phosphonites and peroxide-destroying compounds.

22. A method of stabilizing an acetal homo- or copolymer against thermal or oxidative degradation,

which comprises incorporating into said acetal components (a) and (b) or (a) and (c) according to claim 1.

23. A method of reducing color formation in acetal homo- or copolymers containing component (a) according to claim 1, which comprises incorporating into said acetal homo- or copolymers component (b) or (c) as defined in claim 1.

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 333 660 A3**

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 89810187.8

(22) Date of filing: 09.03.89

(51) Int. Cl.[6]: C08K 5/00, C08L 59/00, //(C08K5/00,5:13,5:20), (C08K5/00,5:13,5:25)

(30) Priority: 18.03.88 US 170187

(43) Date of publication of application: 20.09.89 Bulletin 89/38

(84) Designated Contracting States: DE FR GB IT NL

(88) Date of deferred publication of the search report: 24.07.91 Bulletin 91/30

(71) Applicant: CIBA-GEIGY AG
Klybeckstrasse 141
CH-4002 Basel(CH)

(72) Inventor: Capocci, Gerald A.
25 Greenway Drive
Greenwich, CT 06431(US)
Inventor: Zappia, Jean M.
3 Hollywood Street
Mohegan Lake, NY 10547(US)

(54) **Stabilization systems for polyacetals.**

(57) A blend of a phenolic antioxidant and a hydrazine or oxamido derivative in appropriate proportions for use in stabilizing acetal homo- and copolymers against oxidative and thermal degradation.

EP 0 333 660 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 81 0187

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	DE-B-2 540 206 (DEGUSSA) * claim *	1-23	C 08 K 5/00 C 08 L 59/00 //
A,D	US-A-3 660 438 (M. DEXTER) * example 18 *	1-23	(C 08 K 5/00 C 08 K 5 C 08 K 13
A	US-A-3 152 101 (T. DOLCE) * claims *	1-23	C 08 K 5:20 C 08 K) (C 08 K 5/00
A	DE-A-2 203 836 (CIBA-GEIGY AG) * claims; page 7, lines 11-14 *	1-23	C 08 K 5:13 C 08 K C 08 K 5:25)

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

C 08 K
C 08 L

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	24 May 91	HOFFMANN K.W.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same catagory
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention

E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document